# PATENT COOPERATION TREATY

# PCT

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

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| Applicant's or agent's file reference<br>P06480PC00 | **FOR FURTHER ACTION** | See Form PCT/IPEA/416 |
| International application No.<br>PCT/EP2004/014670 | International filing date *(day/month/year)*<br>23.12.2004 | Priority date *(day/month/year)*<br>29.12.2003 |
| International Patent Classification (IPC) or national classification and IPC<br>H04L1/00, H04L1/18 | | |
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1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *sent to the applicant and to the International Bureau)* a total of 5 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      ☐ sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).

4. This report contains indications relating to the following items:

| | | |
|---|---|---|
| ☒ | Box No. I | Basis of the opinion |
| ☐ | Box No. II | Priority |
| ☐ | Box No. III | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability |
| ☐ | Box No. IV | Lack of unity of invention |
| ☒ | Box No. V | Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| ☐ | Box No. VI | Certain documents cited |
| ☐ | Box No. VII | Certain defects in the international application |
| ☐ | Box No. VIII | Certain observations on the international application |

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|---|---|
| Date of submission of the demand<br>28.10.2005 | Date of completion of this report<br>16.03.2006 |
| Name and mailing address of the international preliminary examining authority:<br>European Patent Office - P.B. 5818 Patentlaan 2<br>NL-2280 HV Rijswijk - Pays Bas<br>Tel. +31 70 340 - 2040 Tx: 31 651 epo nl<br>Fax: +31 70 340 - 3016 | Authorized Officer<br>Papantoniou, A<br>Telephone No. +31 70 340-4116 |

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2004/014670

## Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

   ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:

   ☐ international search (under Rules 12.3 and 23.1(b))
   ☐ publication of the international application (under Rule 12.4)
   ☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

| | |
|---|---|
| 1-12 | as originally filed |
| 3b | received on 28.10.2005 with letter of 28.10.2005 |

**Claims, Numbers**

| | |
|---|---|
| 1-11 | received on 28.10.2005 with letter of 28.10.2005 |

**Drawings, Sheets**

| | |
|---|---|
| 1/4-4/4 | as originally filed |

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets/figs
   ☐ the sequence listing *(specify)*:
   ☐ any table(s) related to sequence listing *(specify)*:

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
   ☐ the description, pages
   ☐ the claims, Nos.
   ☐ the drawings, sheets/figs
   ☐ the sequence listing *(specify)*:
   ☐ any table(s) related to sequence listing *(specify)*:

* *If item 4 applies, some or all of these sheets may be marked "superseded."*

# INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/EP2004/014670

## Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | | |
|---|---|---|---|
| Novelty (N) | Yes: | Claims | 1-11 |
| | No: | Claims | |
| Inventive step (IS) | Yes: | Claims | 1-11 |
| | No: | Claims | |
| Industrial applicability (IA) | Yes: | Claims | 1-11 |
| | No: | Claims | |

2. Citations and explanations (Rule 70.7):

**see separate sheet**

**INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (SEPARATE SHEET)**

International application No.

PCT/EP2004/014670

1. The application relates to a method ( Claim 1 ), a computer program product ( claims 5 and 6 ), a system ( Claim 7 ) and a radio communication device ( Claim 8 ) for automatic repeat request transmission whereby different transmission power and code rates are used for retransmissions.

2. Such a method, computer program product, system and a radio communication device are disclosed by the document **D1:**

D1: US-A-5 671 250 (ZURANSKI EDWARD SIGMUND ET AL) 23 September 1997 (1997-09-23)

3. The essential difference between the subject - matter of claims 1, 5, 6, 7 and 8 and D1 is that the transmitter stores the already transmitted data units along with their sequence number, power and code rate used, so that retransmission of failed data units then proceeds by discarding the successfully received data units (as indicated by an acknowledge message) and incorporating the failed data units that are not discarded from memory into a new set of data units to be transmitted.

4. The problem solved by these features is the unpredictability of channel changes that result in complicated hybrid ARQ implementations.

5. The solution proposed has the advantage that the transmitted data units are stored in the sender and contain individual information ( power, code rate and sequence number ) which facilitates an individual adaptation of transmission characteristics for each data unit, thus enabling a flexible adaptation of retransmission of data units.

6. None of the available documents anticipates the proposed solution. Thus the requirements of novelty ( Art.33(2) PCT), inventive step ( Art.33(3) PCT) and industrial applicability ( Art.33(4) PCT) are all met.

The dependent claims provide additional features the subject-matter of which also involves an inventive step.

7. The present Claim 1 is based of the original claim 6. The original claim 6 was a dependent claim of the original claim 1, claim 1 being deleted from the present claim set. Since original claim 6 included all features of the original claim 1 in a narrower form then present Claim 1 is allowable under Art.19(2) PCT.

Similarly, claim 7 is based on the original claim 16 and claim 8 is based on the original claim 18.

Claims 5 and 6 correspond to the original claims 9 and 10 respectively.

Therefore, the present claims meet the requirements of Art.19(2) PCT.

US patent 6,101,164 discloses methods and systems for automatic repeat request (ARQ) in data packet communication between a sender and a receiver engaged in wireless communication. If a data packet is detected (received) erroneously, an NACK message is sent back to the sender and a correct data packet is retransmitted together with a new data packet. It is also described that the power level of the retransmitted data packets can be varied i.e. increased in order to maintain sufficient energy of the retransmitted data packets. It is also described that the code symbols of the retransmitted packet can be changed.

CLAIMS:

1. A method of automatic repeat request, thereafter referred to as ARQ, in data communication between a sender and a receiver engaged in wireless communication with each other, wherein the sender is provided with an incoming data stream of a plurality of protocol data units, thereafter referred to as PDUs, and the ARQ procedure comprises uses of acknowledgement message, thereafter referred to as ACK, and negative acknowledgement message, thereafter referred to as NACK, the method **characterised by** the steps of:

a)-*grouping* of PDUs (405), wherein a number of PDUs from the to the sender incoming data stream are grouped into a set of PDUs, and each PDUs are given a sequence number, $n$;

b)-*assigning* (410) transmit power and code rate to PDUs, wherein each PDU is assigned a transmit power level value, $P_k$, and a code rate value, $C_k$;

c)-*storing* PDUs (415), wherein the PDUs are stored in a memory along with their sequence number ($n$), and the assigned power level value, $P_k$, and code rate value, $C_k$;

d)-*transmitting* PDUs (420), wherein the PDUs of the set of PDUs are simultaneously transmitted from the sender with their respective power level value, $P_k$, and code rate value, $C_k$;

e)-*receiving* PDUs (425), wherein the transmitted PDUs are received by the receiver, decoded and checked for errors, and PDUs not considered decodeable are recognised as not correctly received;

f)-*feedbacking* (430), wherein the receiver transmits to the sender an ARQ feedback in form of a ACK or NACK message, wherein the ACK or NACK message comprises information on the PDUs which were correctly received or the PDUs which were not correctly received, respectively;

g)-*discarding* correctly received PDUs from memory (435), wherein the sender discards from the memory the temporally stored PDUs which were correctly received, and forms a new set of PDUs comprising the PDUs which were not correctly received.

2. ARQ method according to claim 1 **wherein** the steps b) to g) are repeated (440) and wherein the PDUs which were not correctly received in a first transmission are in a subsequent transmission retransmitted at higher respective power level values, $P_k$, and/or different code rate values, $C_k$, than used in the first transmission.

3. ARQ method according to claim 2, **wherein** in the step of assigning (410) the PDUs are assigned descending power levels with regards to their sequence number so that the PDU with the lowest sequence number is given the highest power level value; and in the step of the PDUs which were not correctly received are given the lowest sequence numbers, and the set is filled up with new PDUs from the incoming data stream.

4. ARQ method according to any of claims 1 to 3, **wherein** at least one of the power level values used for transmitting at least one PDU is below an estimated noise floor

5. Computer program products directly loadable into the internal memory of a processing means within a sender and receiver, comprising the software code means adapted for controlling the steps of any of the claims 1 to 4.

6. Computer program products stored on a computer usable medium, comprising readable program adapted for causing a processing means in a processing unit within a sender and receiver, to control an execution of the steps of any of the claims 1 to 4.

7. A system of at least one sender (510) and at least one receiver (540) adapted to be engaged in mutual wireless data communication, the system using automatic repeat request, thereafter referred to as ARQ, acknowledgement message, thereafter referred to as ACK, and negative acknowledgement message, thereafter referred to as NACK, in the data communication, wherein the sender is provided with an incoming data stream of a plurality of protocol data units, thereafter referred to as PDUs, the system **characterised by** that the sender comprises:

-grouping means (515) for grouping PDUs so that a number of PDUs from the to the sender incoming data stream are grouped into a set of PDUs, and each PDUs are given a sequence number, $n$, and assigning transmit power and code rate to PDUs so that each PDU is assigned a transmit power level value, $P_k$, and a code rate value, $C_k$, which grouping means is arranged to receive an ARQ feedback;

-storing means (517), arranged to be accessible from said grouping means (515), and adapted to store PDUs along with their sequence number, $n$, and the assigned power level value, $P_k$, and/or code rate value $C_k$;

-transmitting means (530) for transmitting PDUs so that the PDUs of the set of PDUs are essentially simultaneously transmitted from the sender with their respective power level value, $P_k$, and code rate value, $C_k$;

-discarding means (518), arranged to be accessible from said grouping means (515), for discarding correctly received PDUs from memory the temporally stored PDUs which were correctly received, and forming a new set of PDUs comprising the PDUs which were not correctly received,
and by that the receiver comprises:
-means for receiving, decoding and checking (545) PDUs for errors (CRC), and recognising PDUs which are not considered decodeable as not correctly received;
-feedbacking means (550) for feedbacking to the sender an ACK or NACK message, wherein the ACK or NACK message comprises information on the PDUs which were correctly received or the PDUs which were not correctly received, respectively.

8. A radio communication device adapted for data communication by transmitting a plurality of protocol data units, thereafter referred to as PDUs with the use of automatic repeat request, thereafter referred to as ARQ, acknowledgement message, thereafter referred to as ACK, and negative acknowledgement message, thereafter referred to as NACK, the radio communication device **characterised by**
a transmitter unit (510) comprising:
-grouping means (515) for grouping PDUs so that a number of PDUs from a to the transmitter unit (510) incoming data stream are group into a set of PDUs, and each PDUs are given a sequence number, $n$, and assigning transmit power and code rate to PDUs so that each PDU is assigned a transmit power level value, $P_k$, and a code rate value, $C_k$, which grouping means is arranged to receive an ARQ feedback;
-storing means (517), arranged to be accessible from said grouping means (515), and adapted to store PDUs along with their sequence number, $n$, and the assigned power level value, $P_k$, and/or code rate value, $C_k$;
-transmitting means (530) for transmitting PDUs so that the PDUs of the set of PDUs are simultaneously transmitted from the sender with their respective power level value, $P_k$, and code rate value, $C_k$;
-discarding means (518), arranged to be accessible from said grouping means (515), for discarding correctly received PDUs from memory the temporally stored PDUs which were correctly received, and forming a new set of PDUs comprising the PDUs which were not correctly received.

9. Radio communication device according to claim 8, **further comprising** receiving unit (540) comprising:
-means for receiving, decoding and checking (545) PDUs for errors (CRC), and

recognising PDUs which are not considered decodeable as not correctly received;
-feedbacking means (550) for feedbacking to the sender an ACK or NACK message, wherein the ACK or NACK message comprises information on the PDUs which were correctly received or the PDUs which were not correctly received, respectively.

10. Radio communication device according to claim 1 or 9, **wherein** the radio communication device is a mobile terminal for use in a cellular radio communication system.

11. Radio communication device according to claim 1 or 9, **wherein** the radio communication device is a radio base station for use in a cellular radio communication system.